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# The relationship between social support and suicidal ideation among newly diagnosed people living with HIV: the mediating role of HIV-related stress

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## ABSTRACT

Evidence have consistently shown social support to be protective against suicidal ideation among people living with HIV (PLWH), but little is known how social support protects PLWH from suicidal ideation. We aimed to explore whether social support could reduce suicidal ideation by reducing HIV-related stress levels or depression among PLWH during the early post-diagnosis phase. A cross-sectional study of 557 newly diagnosed PLWH was conducted. Information on suicidal ideation, social support, HIV-related stress and depression was collected using a self-administered questionnaire. Generalized structural equation modeling (GSEM) analyses were performed to determine the mediating effect of HIV-related stress and depression on the relationship between social support and suicidal ideation. One-fourth of participants reported considering suicide after HIV diagnosis. Higher social support could prevent PLWH from suicidal ideation directly or indirectly via reducing the HIV-related stress levels. The mediating effect of depression, as well as the chain mediating effect of HIV-related stress and depression were not found. Enhancing social support and reducing HIV-related stress are important to prevent suicide among PLWH.

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## KEYWORDS

Suicidal ideation; social support; HIV-related stress; depression; newly diagnosed people living with HIV

## Introduction

More than 3 decades into the HIV epidemic, suicide prevention among people living with HIV (PLWH) remains a priority for researchers (Catalan et al., 2011). Suicidal ideation has been identified as the most proximal risk factor for suicide (Klonsky et al., 2016), which is closely associated with the psychosocial status among PLWH (Kang et al., 2016).

Most individuals would suffer from a myriad of stressors after HIV diagnosis (Martinez et al., 2012). Greater stress has been linked with severe depression (Garrido-Hernansaiz & Alonso-Tapia, 2017), both of which contribute to an increased risk of suicidal ideation (O'Donnell et al., 2016). Social support, an established moderator, could mitigate the

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negative psychological consequences of stressful experiences, such as stress, depression and suicidal ideation followed HIV diagnosis (Amiya et al., 2014; Rzeszutek, 2018).

Although studies have elaborated on the relationship between these factors, issues like how social support protects PLHW from suicidal ideation, whether social support could reduce suicidal ideation by reducing HIV-related stress levels and depressive symptoms remain unclear. Identifying the interaction mechanism between these factors may provide important additional information for suicide prevention.

Therefore, this study aimed to explore the mediating role of HIV-related stress and depression on the relationship between social support and suicidal ideation among newly diagnosed PLWH. We hypothesized that higher social support: (1) has a negative direct effect on suicidal ideation; (2) has a negative indirect effect on suicidal ideation through HIV-related stress or depression; and (3) HIV-related stress and depression together have a chain mediating effect on the relationship between social support and suicidal ideation (Figure 1).

## Methods

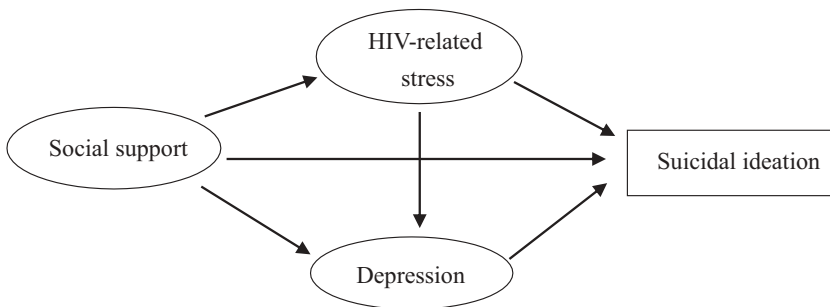
### Participants

From 1 March 2013 to 30 September 2014, a cross-sectional study was conducted at the Changsha Center for Disease Control and Prevention, China. PLWH were consecutively recruited if they: (a) aged  $\geq 18$  years; (b) were confirmed sero-positive within 1 month; (c) had been living in Changsha  $\geq 6$  months. The IEC of Institute of Clinical Pharmacology at Central South University approved this study (CTXY-120 033-3). All participants provided written informed consent before participation.

### Measurements

#### Suicidal ideation

A single yes/no item was used: 'Have you thought about suicide after HIV diagnosis?' The answer of 'yes' was considered as having suicidal ideation.



**Figure 1.** Hypothesized model for relationships between social support, HIV-related stress, depression and suicidal ideation among newly diagnosed PLWH (n = 557).

### ***Social support***

Social support was measured with the Social Support Rating Scale (SSRS) (Xiao, 1999), including 10-item with 3 dimensions: objective social support (e.g. how much practical supports did you receive), subjective social support (e.g. how many close friends do you have), and utility of social support (e.g. what methods would you use if you are in trouble). Higher score indicates higher social support. The SSRS has been widely used in different populations, with an overall Cronbach's  $\alpha$  coefficient of 0.794 in PLWH (Yan et al., 2019).

### ***HIV-related stress***

HIV-related stress was measured with the Chinese HIV/AIDS Stress Scale (CSS-HIV) (Niu et al., 2016), including 3 dimensions: emotional stress, social stress, and instrumental stress. Participants were asked how much did stressors affect them in the last month. Higher score indicates greater stress levels. The CSS-HIV gives good validity and reliability, with an overall Cronbach's  $\alpha$  coefficient of 0.906.

### ***Depression***

Depression was measured with the 9-item Patient Health Questionnaire (PHQ-9) (Kroenke et al., 2001). Participants were asked the frequency of depressive symptoms in the last 2 weeks. Higher score indicates more severe depression. The PHQ-9 in PLWH shows good validity and reliability, with a Cronbach's  $\alpha$  coefficient of 0.780 (Monahan et al., 2009).

### ***Socio-demographic and clinical information***

Socio-demographic information included gender, age, residence, marital status, education, employment, individual monthly income and transmission mode. Clinical information included CD4 count and symptoms.

### ***Data analysis***

Sample characteristics were analyzed descriptively and bivariate analysis was conducted to identify factors associated with suicidal ideation. Generalized structural equation modeling (GSEM) analyses were performed to determine whether the relationship between social support and suicidal ideation was mediated by HIV-related stress and depression, after controlling the socio-demographic and clinical variables significantly associated with suicidal ideation in the bivariate analysis. Detailed introduction of the GSEM processing is available in Appendix A. All analyses were conducted in STATA MP 16.0 (Stata, Corporation Texas, USA).

## **Results**

### ***Psychosocial characteristics and suicidal ideation***

There were 557 newly diagnosed PLWH completing this survey, with a median diagnosis duration of 13 days (interquartile ranges, IQR 10–17), of which 139 (25.0%) reported

considering suicide after diagnosis (Table 1). The median score of social support was 29 (IQR 23–34), HIV-related stress 26 (IQR 15–40), and depression 7 (IQR 3–13).

### Bivariate analysis

Bivariate analysis showed that suicidal ideation was significantly associated with income, symptoms, social support, HIV-related stress, and depression (Table 1).

### Results of GSEM

GSEM analysis showed that higher social support had a negative direct effect ( $SC = 0.7564$ ,  $p < 0.001$ ) on suicidal ideation (Table 2) and a partly negative indirect effect ( $SC = -0.1203$ ,  $p < 0.01$ ) through HIV-related stress (Table 3). However, the mediating role of depression ( $SC = -0.0069$ ,  $p = 0.337$ ) and the chain mediating role of

**Table 1.** Sample characteristics of 557 participants.

Characteristics	Total <i>n</i> (%)	Suicidal ideation <i>n</i> (%)		<i>p</i> value
		Yes ( <i>n</i> = 139)	No ( <i>n</i> = 418)	
Gender				
Male	515 (92.5)	133 (95.7)	382 (91.4)	0.097 <sup>a</sup>
Female	42 (7.5)	6 (4.3)	36 (8.6)	
Age				
18-29	315 (56.6)	77 (55.4)	238 (56.9)	0.949 <sup>a</sup>
30-39	124 (22.3)	32 (23.0)	92 (22.0)	
≥40	118 (21.2)	30 (21.6)	88 (21.1)	
Household registration				
Urban	283 (50.8)	214 (51.2)	69 (49.6)	0.751 <sup>a</sup>
Rural	274 (49.2)	204 (48.8)	70 (50.4)	
Marital status				
Single	347 (62.3)	85 (61.2)	262 (62.7)	0.146 <sup>a</sup>
Married	139 (25.0)	30 (21.6)	109 (26.1)	
Divorced/widowed	71 (12.7)	24 (17.3)	47 (11.2)	
Education				
Primary school or below	31 (5.6)	5 (3.6)	26 (6.2)	0.490 <sup>a</sup>
Junior high school	105 (18.9)	25 (18.0)	80 (19.1)	
High school	166 (29.8)	47 (33.8)	119 (28.5)	
College or above	255 (45.8)	62 (44.6)	193 (46.2)	
Employment				
Employed	391 (70.2)	90 (64.7)	301 (72.0)	0.105 <sup>a</sup>
Unemployed/retired/other	166 (29.8)	49 (35.3)	117 (28.0)	
Income (yuan)				
≤ 4000	339 (60.9)	95 (68.3)	244 (58.4)	0.037 <sup>a</sup>
> 4000	218 (39.1)	44 (31.7)	174 (41.6)	
Transmission mode				
Heterosexual	226 (40.6)	48 (34.5)	178 (42.6)	0.206 <sup>a</sup>
Homosexual	322 (57.9)	89 (64.0)	233 (55.7)	
Other	9 (1.6)	2 (1.4)	7 (1.7)	
CD4 count (cells/mm <sup>3</sup> )				
< 200	77 (13.8)	20 (14.4)	57 (13.6)	0.258 <sup>a</sup>
200-500	369 (66.3)	98 (70.5)	271 (64.8)	
> 500	111 (19.9)	21 (15.1)	90 (21.5)	
Symptoms				
Without	358 (64.3)	56 (40.3)	302 (72.2)	< 0.001 <sup>a</sup>
With	199 (35.7)	83 (59.7)	116 (27.8)	
Social support, median (IQR)	29.0 (23.0–34.0)	26.0 (19.0–31.0)	30.0 (25.0–35.0)	< 0.001 <sup>b</sup>
HIV-related stress, median (IQR)	26.0 (15.0–39.5)	42.0 (31.0–54.0)	22.0 (13.0–33.0)	< 0.001 <sup>b</sup>
PHQ-9, median (IQR)	7.0 (3.0–13.0)	14.0 (8.0–19.0)	6.0 (2.0–10.0)	< 0.001 <sup>b</sup>

IQR: Interquartile range; <sup>a</sup> Chi-square test; <sup>b</sup> Mann–Whitney test

**Table 2.** Results of GSEM, direct effects (n = 557).

Variables	SC	SE	95% CI	p value
Social support→Suicidal ideation	0.7564 <sup>a</sup>	0.0597	(0.6480, 0.8831)	< 0.001
HIV-related stress→Suicidal ideation	1.097 <sup>a</sup>	0.033	(1.0343, 1.1652)	0.002
Depression→Suicidal ideation	1.1256 <sup>a</sup>	0.1008	(0.9443, 1.3416)	0.187
Social support→HIV-related stress	-1.2891 <sup>b</sup>	0.2038	(-1.6886, -0.8896)	< 0.001
Social support→Depression	-0.0582 <sup>b</sup>	0.0472	(-0.1507, 0.0342)	0.217
HIV-related stress→Depression	0.2735 <sup>b</sup>	0.2334	(0.2277, 0.3193)	< 0.001

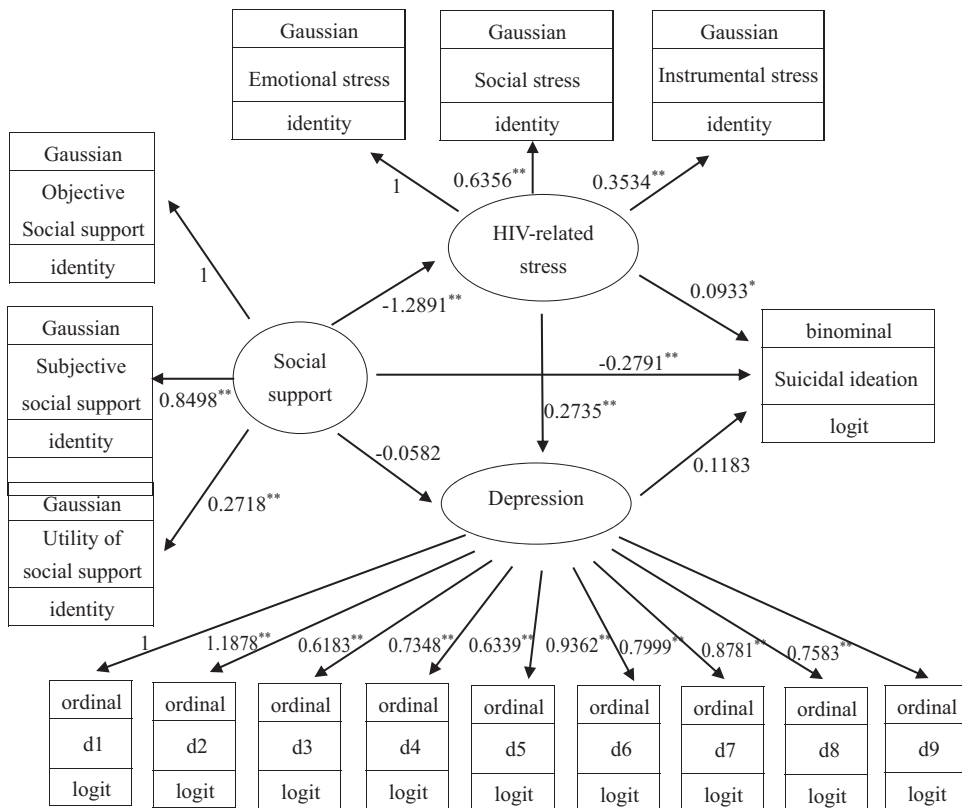
SC: standard coefficient; SE: standard error; <sup>a</sup> measure effect is OR; <sup>b</sup> measure effect is β

**Table 3.** Results of GSEM, indirect effects (n = 557).

Variables	SC	SE	95% CI	p value
Social support→HIV-related→stress Suicidal ideation	-0.1203	0.0425	(-0.2036, -0.0369)	0.005
Social support→Depression→Suicidal ideation	-0.0069	0.0072	(-0.0209, 0.0072)	0.337
Social support→HIV-related stress→Depression→Suicidal ideation	-0.0417	0.0322	(-0.1048, 0.0214)	0.196

SC: standard coefficient; SE: standard error

HIV-related stress and depression on the relationship between social support and suicidal ideation (SC = - 0.0417, p = 0.196) were not significant. Figure 2 shows the final model of GSEM.



**Figure 2.** Final model for associations between social support, HIV-related stress, depression and suicidal ideation among newly diagnosed PLWH (n = 557).

Note: The individual monthly income and HIV-related symptoms were controlled as covariates in the GSEM; d1-d9: items of PHQ-9 scale; \*p < 0.05; \*\* p < 0.001

## Discussion

The rate of suicidal ideation among newly diagnosed PLWH in this study is much higher than that in the general population (Cao et al., 2015) and in PLWH with a longer duration of time since diagnosis (Malava et al., 2018), suggesting the importance of providing accessible mental health services for PLWH immediately after diagnosis.

As hypothesized, higher social support could prevent PLWH from suicidal ideation directly or indirectly via reducing the HIV-related stress levels. Adequate social support may help patients cope with stressful events, largely protect them from psychological distress, and thus reduce the risk of suicidal ideation (Rzeszutek, 2018; Tang et al., 2018). These finds suggest that in addition to increasing social support, reducing HIV-related stress should also be considered in suicide prevention among PLWH.

Incompatible with the hypothesis, the mediating effect of depression and chain mediating effect of HIV-related stress and depression on the relationship between social support and suicidal ideation were not significant. The mediating effect of depression was significant in the model only included depression as a mediator, but this mediating effect disappeared when HIV-related stress was simultaneously included (see Appendix A).

Once diagnosed with HIV, he/she must struggle with multiple HIV-related stressors, such as stigma, disclosure and treatment, but do not necessarily suffer from depressive symptoms such as losing interest in doing things, trouble concentrating on things or feeling bad about themselves. In a sense, PLWH may be more vulnerable to HIV-specific stressors than depressive symptoms during the early post-diagnosis phase. The HIV-related stress may be a more powerful predictor of suicidal ideation in the early stage of infection and may overshadow the effect of depression on suicidal ideation. Future research should confirm this result and explore further potential explanations.

This study has several limitations. Participants were recruited by a convenience sampling, which may limit the generalizability of results. Other psychological problems that may be also potential mediators between social support and suicidal ideation, such as anxiety and post-traumatic stress disorder, were not considered in this study. These psychological variables should be considered in future studies. Additionally, it has been about 6 years since the data collection was finished. The guideline for the treatment of HIV disease has changed over this period, from treatment at a CD4 count of  $\leq 500$  cells/mm<sup>3</sup> in 2014, to recommending treatment immediately after diagnosis regardless of CD4 count in 2016 (National Health and Family Planning Commission, 2016). The psychosocial status of PLWH who were diagnosed about 6 years ago in this study may not fully reflect the status of PLWH diagnosed in recent years.

Despite these limitations, this study provides important additional information for suicide prevention among PLWH. Higher social support could prevent PLWH from suicidal ideation directly or indirectly via reducing the HIV-related stress levels. Interventions such as enhancing social support and reducing HIV-related stress may be important in the prevention of suicide among PLWH.

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## Disclosure statement

No potential conflict of interest was reported by the authors.

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## Ethics approval and consent to participate

This study was approved by the Human Research Ethics Committee of Central South University (CTXY-120 033-3), and all participants had provided written informed consent before participation.

## Data availability statement

The data that support the findings of this study are available on request from the corresponding author, D L. The data are not publicly available due to their containing information that could compromise the privacy of research participants.

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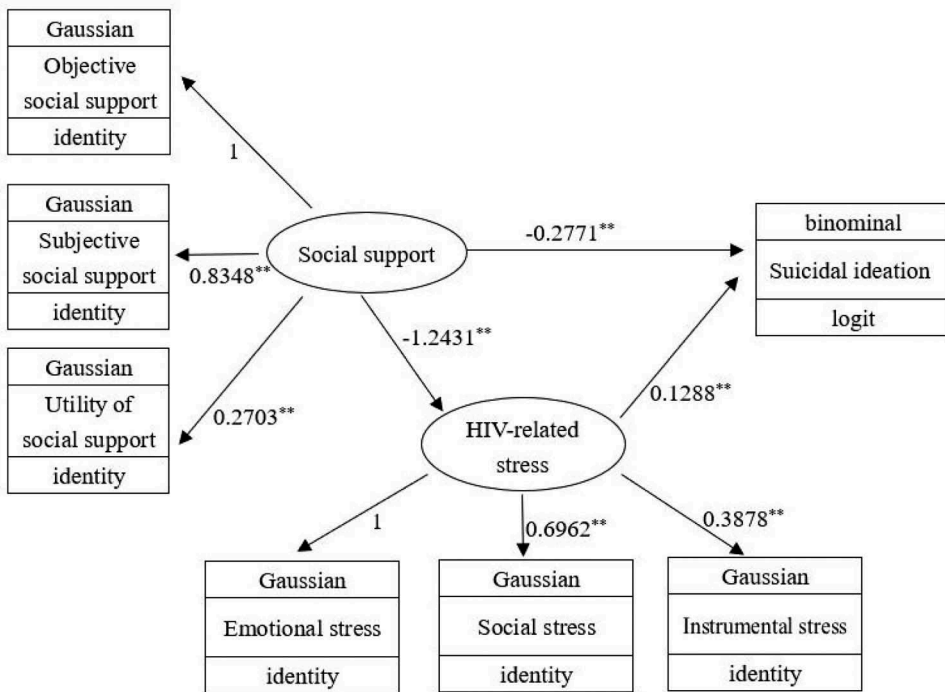
## Appendix A. Details of the GSEM processing

The generalized structural equation modeling (GSEM), an advantageous method exploring the mediating effect on categorical variables, was performed to determine whether the relationship between social support and suicidal ideation was mediated by HIV-related stress and depression (Rabe-Hesketh, Skrondal, & Pickles, 2004; Stata, 2016).

The item parceling method was used before the GSEM analysis, given a large number of items for the SSRS and CSS-HIV (Niu et al., 2016; Xiao, 1999). A latent construct with multiple single items may be problematic for structural equation models, such as the difficulty in making model identification and a higher likelihood of improper solutions (Hall, Snell, & Foust, 1999). The item parceling method has been shown to be useful in stabilizing parameter estimates and improving model fit (Hall et al., 1999; Nasser & Wisenbaker, 2003). According to the original structure of SSRS (Xiao, 1999) and CSS-HIV (Niu et al., 2016), the items of both were parceled into three indicators, respectively, and their measurement models in GSEM were analyzed using the 'Gaussian' family and 'identity' link function.

Considering the PHQ-9 includes nine items with ordered answers, the ‘ordinal’ family and ‘logit’ link function were selected for the measurement model. Suicidal ideation as a binary outcome variable was fitted with ‘binominal’ family and ‘logit’ link function.

In the process of model building, we first conducted two models separately to determine whether HIV-related stress and depression mediate the relationship between social support and suicidal ideation. Model 1 included HIV-related stress as a single mediator (see Figure 1 and Table 1 in this supplementary file) and model 2 included depression as a single mediator (see Figure 2 and Table 2 in this supplementary file). After then, HIV-related stress and depression were entered simultaneously in the GSEM model to determine the independent mediating effects of them on the relationship between social support and suicidal ideation. Sociodemographic and clinical variables



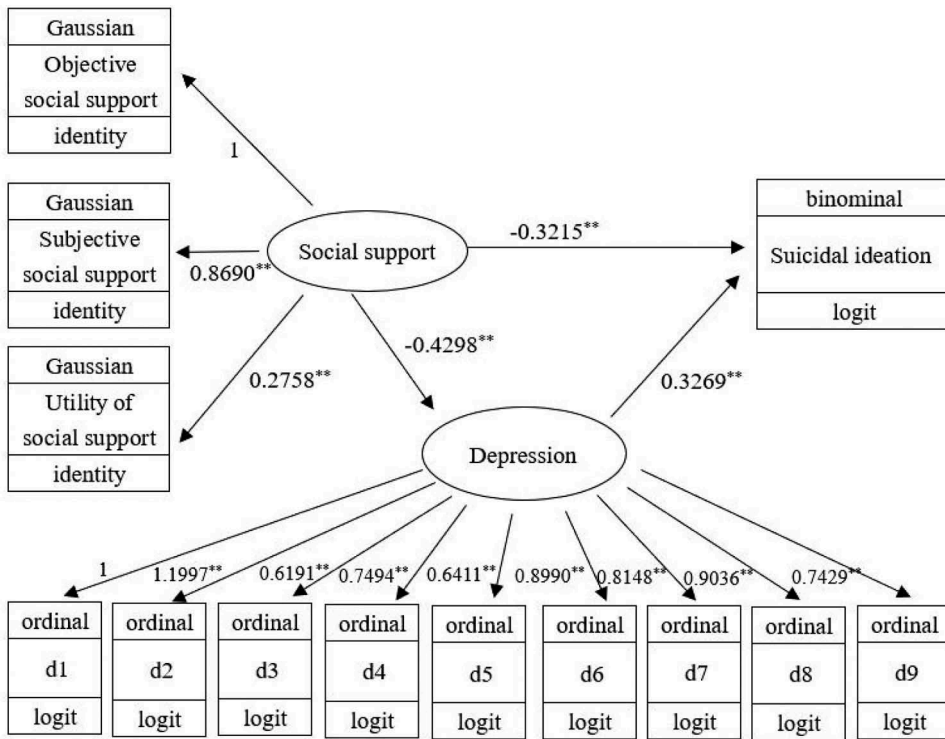
**Figure A1.** Model 1 for relationships between social support, HIV-related stress and suicidal ideation among newly diagnosed PLWH (n = 557).

Note: The individual monthly income and HIV-related symptoms were controlled as covariates in the GSEM; \*  $p < 0.05$ ; \*\*  $p < 0.001$

**Table A1.** Results of the mediating effect of HIV-related stress on the relationship between social support and suicidal ideation (n = 557).

Model 1	SC	SE	95% CI	p value
<b>Direct effect</b>				
Social support → Suicidal ideation	0.7580 <sup>a</sup>	0.0598	(0.6494, 0.8847)	< 0.001
HIV-related stress → Suicidal ideation	1.1374 <sup>a</sup>	0.0241	(1.0911, 1.1857)	< 0.001
Social support → HIV-related stress	-1.2431 <sup>b</sup>	0.1995	(-1.6341, -0.8522)	< 0.001
<b>Indirect effect</b>				
Social support → HIV-related stress → Suicidal ideation	-0.1601	0.0349	(-0.2284, -0.0917)	< 0.001

SC: standard coefficient; SE: standard error; <sup>a</sup> measure effect is OR; <sup>b</sup> measure effect is  $\beta$



**Figure A2.** Model 2 for relationships between social support, depression and suicidal ideation among newly diagnosed PLWH (n = 557).

Note: The individual monthly income and HIV-related symptoms were controlled as covariates in the GSEM; d1-d9: items of PHQ-9 scale; \*  $p < 0.05$ ; \*\*  $p < 0.001$

**Table A2.** Results of the mediating effect of depression on the relationship between social support and suicidal ideation (n = 557).

Model 2	SC	SE	95% CI	p value
<b>Direct effect</b>				
Social support→Suicidal ideation	0.7251 <sup>a</sup>	0.0586	(0.6188, 0.8495)	< 0.001
Depression→Suicidal ideation	1.3867 <sup>a</sup>	0.0859	(1.2282, 1.5657)	< 0.001
Social support→Depression	-0.4298 <sup>b</sup>	0.0818	(-0.5902, -0.2695)	< 0.001
<b>Indirect effect</b>				
Social support→Depression Suicidal→ideation	-0.1405	0.0331	(-0.2054, -0.0757)	< 0.001

SC: standard coefficient; SE: standard error; <sup>a</sup> measure effect is OR; <sup>b</sup> measure effect is  $\beta$

significantly associated with suicidal ideation in the bivariate analysis including individual monthly income and HIV-related symptoms were controlled as covariates in each GSEM model.

In GSEM, the effect of each independent or mediating variable on its corresponding dependent variable was shown as the standard coefficient (SC) along with the arrow line, and the further mediating effects (indirect effects) were estimated using the nonlinear combination command (nlcom) (Stata, 2016). The measure effects were presented as odds ratios (OR) when suicidal ideation (binary variable) was the outcome variable and were presented as  $\beta$  values when HIV-related stress and depression (continuous variables) were the outcome variables.

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